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ANALYSIS OF THE EFFECTS OF FORMULA FINANCING ON ONTARIO UNIVERSITIES PART I SUMMARY, ANALYSIS AND CONCLUSIONS

by

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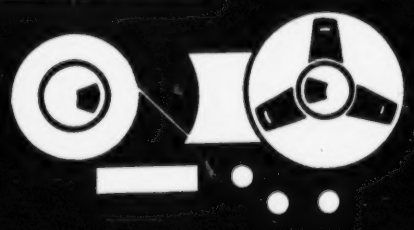

OFFICE OF INSTITUTIONAL RESEARCH

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SUMMARY

This paper is a study of the implications of formula financing for the universities of Ontario. Special reference is made to how the University of Toronto would have fared financially if the formula had been operating in the three years 1963/64 - 1965/66.

The analytical tool employed was a computer model which accepted input data consisting of:

(1) Actual student enrollment data for all Ontario universities.

(2) Actual income received by Ontario universities from fees, federal grants, and provincial grants.

(3) The proposed weights of the formula recommended by the Report to the Committee on University Affairs.

Main conclusions of the analysis are:

(1) The University of Toronto would have received a somewhat larger provincial grant under the formula than in fact it did receive.

(2) The composition of enrollment was such as to produce about 2 basic income units per student at the University of Toronto. This figure increased slightly in 1964/65 and 1965/66.

(3) The imputed value of the basic income unit increased by about $114 per year in 1964/65 and 1965/66.

(4) In 1965/66, the imputed value of the basic income unit was $1,184.

(5) The University of Toronto accounted for about 40 per cent of all basic income units in the province. This per cent shifted downward in 1964/65 and 1965/66 because of relatively faster growing enrollments in other Ontario universities.

ANALYSIS OF THE EFFECTS OF FORMULA FINANCING ON ONTARIO UNIVERSITIES

Purpose of the Study on Formula Financing

The purpose of the study was to test the effect on the University of Toronto of the operating grant formula proposed in the Report to the Committee on University Affairs. 1/

Subsequent to issuance of the report and as a result of comments at the Central Budget Committee Meeting on September 20, it became evident that a "what might have been" type of analysis over several past years would be helpful in determining just how formula financing would affect the University of Toronto.

The study was undertaken shortly thereafter and the results are presented herein and in the accompanying computer report OIR-4B.

Operation of the Proposed Formula

The proposed financing formula has the following basic components: (1) enrollment in course categories (2) weights assigned to the course categories and (3) the values of the basic income units for the years over which the formula is applied.

Current enrollment in course categories is determined from actual records and, where speculative analysis is desired, future enrollment is estimated from forecasted data. Weights are

1/ Report to the Committee on University Affairs, A Formula for Operating Grants to Provincially Assisted Universities in Ontario Submitted by the Subcommittee on Finance of the Committee on University Affairs, Department of University Affairs, Undated.

placed on course categories roughly in proportion to the unit costs of processing students through the courses. Appendix A contains the weights suggested by the report.

The initial value of a basic income unit is determined in part by historical analysis and in part by subjective judgment. Certainly, in establishing a base value for a basic income unit, it would be helpful to impute a value from analysis of past and current data and then subject it to the test of reasonableness in consideration of financial constraints.

For a simple example of the application of the formula using the weights of Appendix A assume the following data:

Course	Category	Weight	Enrollment	Weighted Enrollment
General Arts	1	1.0	500	500
General Science	1	1.0	300	300
Commerce	2	1.5	200	300
Engineering	3	2.0	300	600
Masters-Law	6	3.0	100	300
Totals		8.5	1,400	2,000

Assume also that the value of a basic income unit is $1,000. Then, this hypothetical university of 1,400 students would show a basic operating income of $2,000,000 which is, of course, the product of $1,000 and a weighted enrollment of 2,000. Further, another indicator important to the university is the average basic income unit per student. For this hypothetical university the value is 2000/1400; approximately 1.43. Other things being equal, any change which increases this ratio will cause the university to

realize more income. This will be profitable to the extent that the incremental income exceeds the incremental cost. Professor Judy considers this question in detail in an accompanying paper. 2/

According to the proposed formula, university operating income is to be derived from three principal sources: student fees, federal grants, and provincial grants.

The provincial contribution to a university's basic operating income is to be calculated by subtracting the sum of student fee income and federal grant income from formula-determined basic operating income. Thus, for our hypothetical example, assuming federal grants income of $400,000 and student fee income of $300,000.,

Province Contribution = 2,000,000 - (Federal Grant + Student Fees)

= 2,000,000 - (400,000 + 300,000)

= $1,300,000

Given that the above values applied, our hypothetical university could expect to receive $1,300,000 in operating income from the Province.

The Model for Analysis

The years 63/64, 64/65, and 65/66 were selected for the analysis to show what basic operating incomes would have resulted for the Ontario universities had the formula actually been in

2/ R. W. Judy, On Formula Financing, OIR-5, Office of Institutional Research, University of Toronto, 28 October 1966.

effect during those years. A computer model was designed which makes the necessary calculations to provide the following arrays of data for the years, 1963/64 through 1965/66.

(1) Number of students by university and course.

(2) Numbers of income units by university and course.

(3) Basic operating income by university and course.

(4) Percentage distribution of basic operating income for each course across all universities.

(5) Percentage distribution of basic operating income to all courses within a university.

Array (3) was obtained by imputing to each university an income unit value computed by dividing the total income units for all universities by the total actual basic operating income for all universities. For example, in the year 1963/64 the total income units for all universities was 65,307. The actual total basic operating income (i.e., the sum of student fees, federal grant and provincial grant actually received in 1963/64) for all universities was $62,517,000. This value is then assigned as an income unit value to each university. 3/ Next, the product of university income units times unit value is calculated yielding to the University of Toronto for 63/64 a total basic operating income of $25,909,906. 4/

3/ This equal assignment ignores the fact that emerging universities will get a larger slice than mature universities. Since we do not know how this particular problem would be treated we could do no more than recognize that it does exist.

4/ All values are approximate since data for analysis varied slightly from source to source. It is of little importance however, because the possible small error is distributed over all universities. Sources of data are contained in Appendix B to this report.

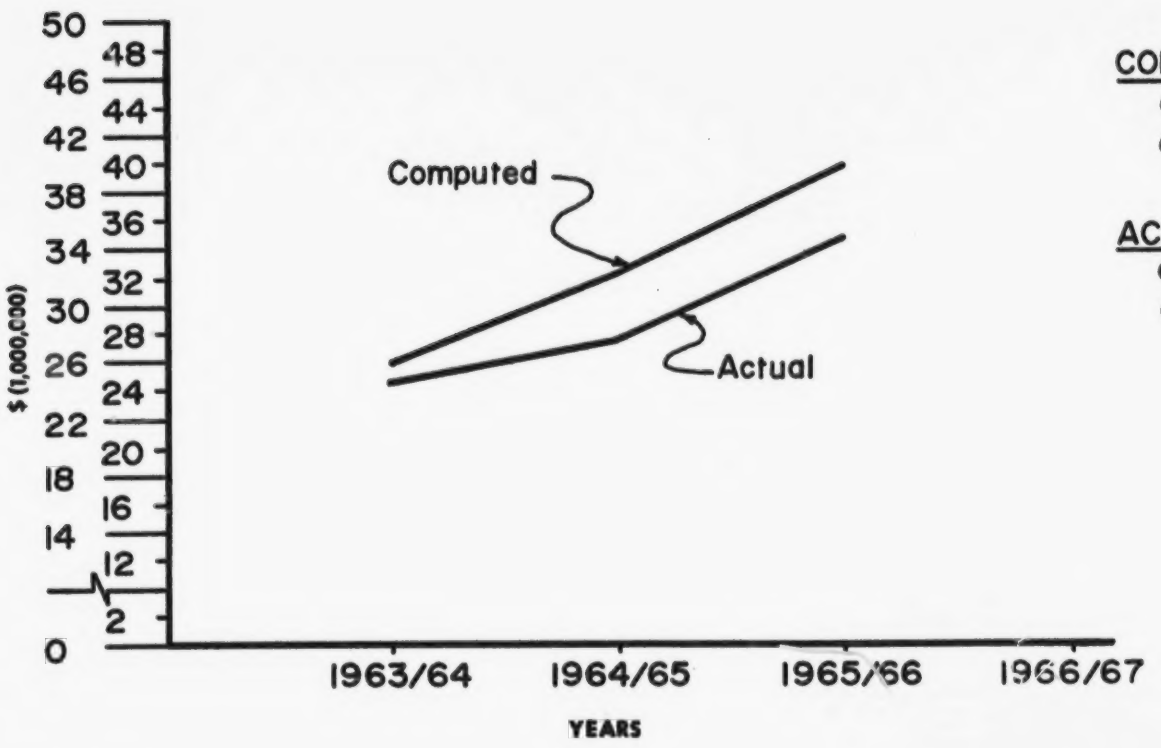
To deepen the analysis, the imputed values of basic income units were replaced with assumed values. These generated a range of basic operating incomes for all universities in each of the three years. This aspect of the analysis will have its most powerful effect in the analysis to be described in OIR-4C scheduled for issue shortly. For estimates of future income it is necessary to forecast enrollment and simulate income using an income unit value which is unknown but predictable within certain limits. The analysis of OIR-4C will display the results of forecasting enrollment and incrementing values of basic income units.

Results of Analysis

The arrays yielded by application of the model to data for the years 63/64 through 65/66 enable the construction of several comparative illustrations. In each case the comparisons are made using derived or imputed values of basic income units.

FIGURE 1

University of Toronto, Basic Operating Income, Actual and Computed, 1963/64-1965/66
(millions of dollars)



COMPUTED — Computed basic operating income based on actual fees and grants.

ACTUAL — Actual basic operating income including fees and operating grants received.

Figure 1 is a comparison of University of Toronto formula-computed operating income to actual operating income for the years under study.

It is safe to infer that even though emerging universities would shave off an additional slice of the total income, Toronto would still have fared well under formula financing and may be expected to fare well if it is applied as proposed.

TABLE 1

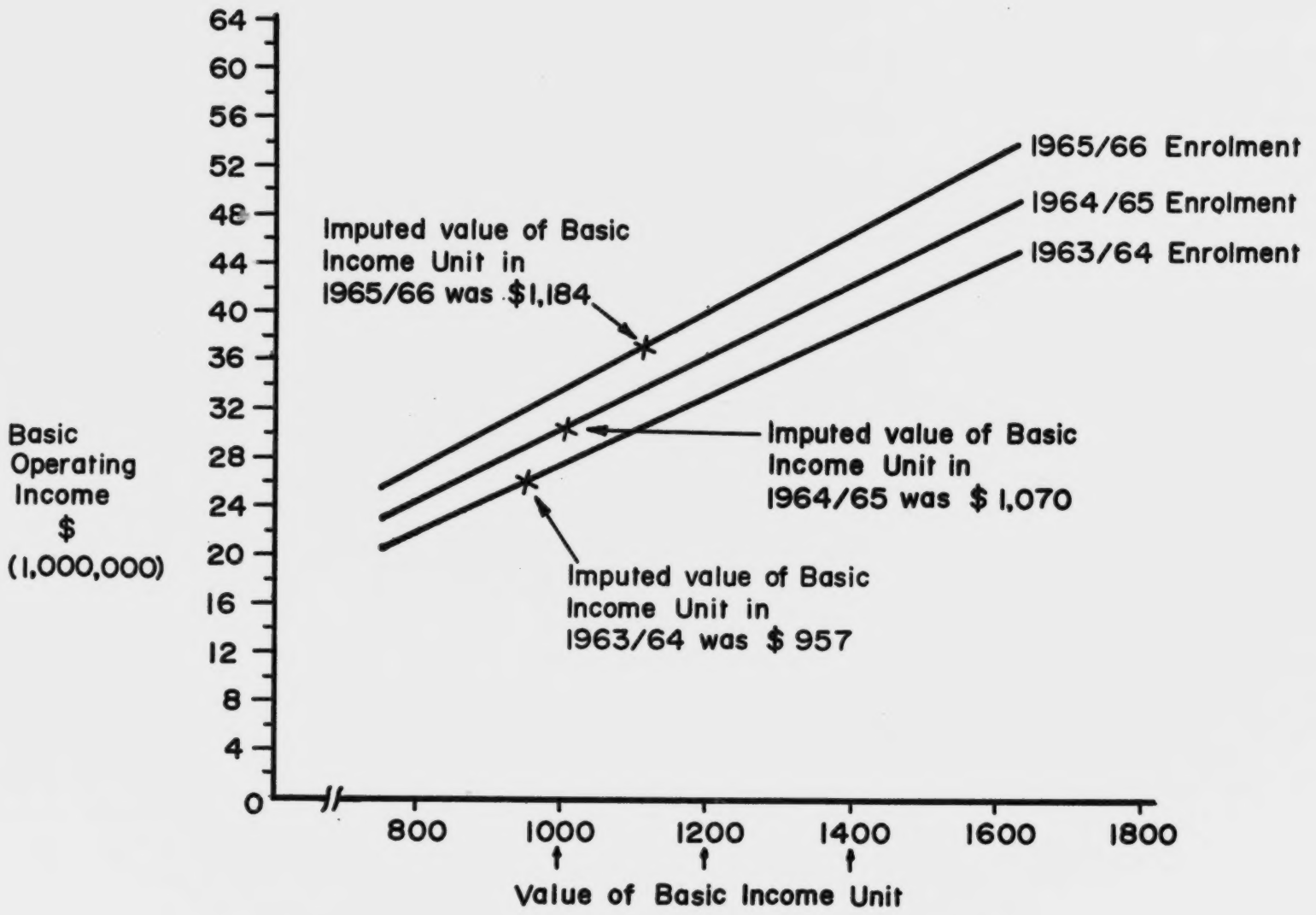
University of Toronto, Actual vs Computed Basic Operating Income, 1963/64-1965/66

	1963/64	1964/65	1965/66
Computed Basic Operating Income	25.9	32.3	39.8
Less:			
Fees	5.8	7.0	8.0 (est.)
Federal Grant	3.7	3.7	4.2
Equals:			
Computed Provincial Grant	16.4	21.6	27.6
Actual Provincial Grant	14.8	16.7	22.5 (est.)
Excess of Computed Provincial Grant over Actual Provincial Grant	+ 1.6	+ 4.9	+ 5.1

Table 1 presents the same kind of information from the viewpoint of provincial government contribution to income. It shows the excess of computed provincial grants over actual provincial grants for the years under study. The net differences are the same as shown by Figure 1.

FIGURE 2

University of Toronto, Relation Between Basic Operating Income Value of Basic Income Unit, and Enrolment in 1963/64, 1964/65 and 1965/66.

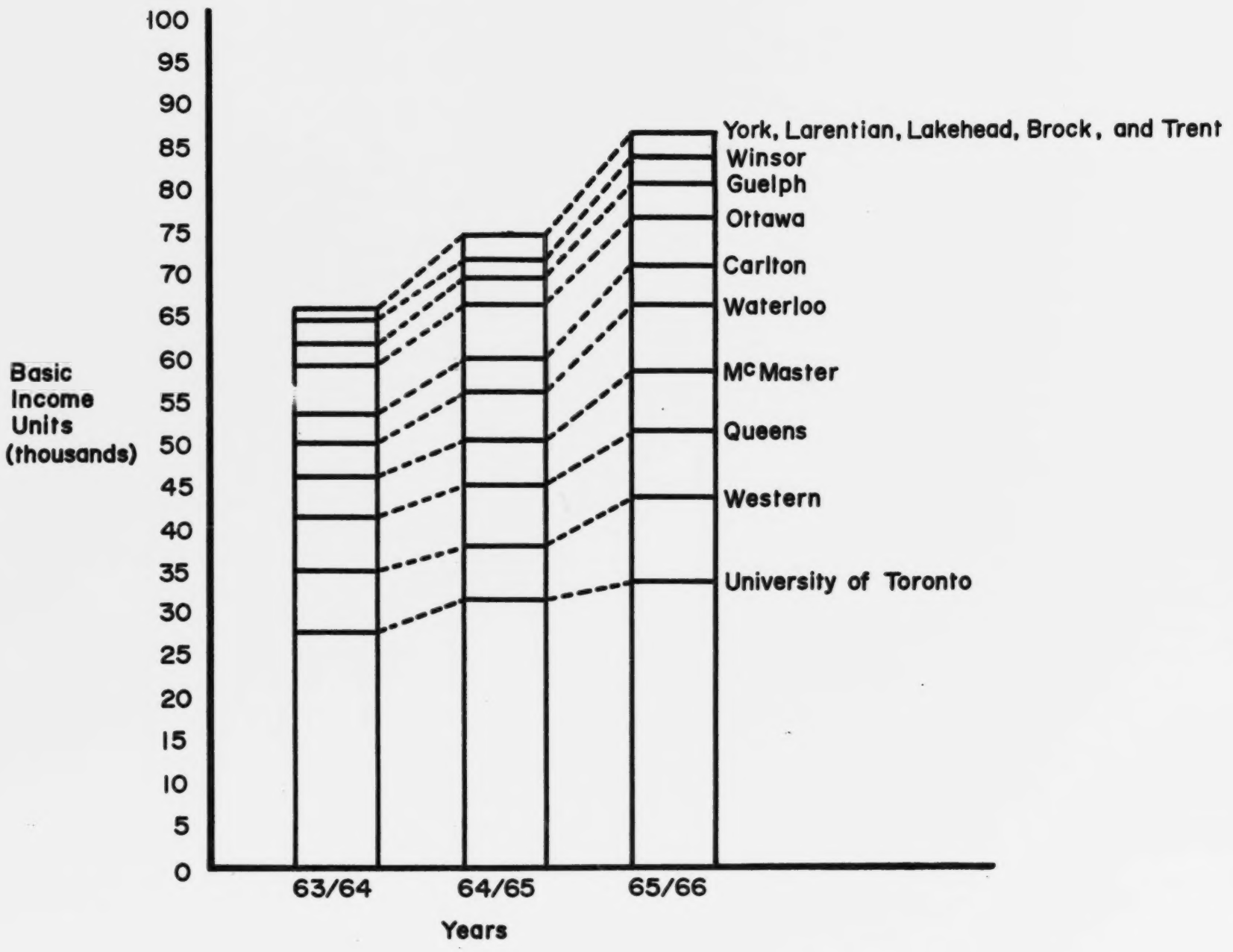


The curves of Figure 2 were formed by connecting plots of imputed and assumed values of basic income units for each of the years under study.

In interpreting the curves one might wish to speculate what income would accrue were enrollment to stabilize at the 1965/66 level. Incrementing basic income unit values along the 1965/66 enrollment line would yield outputs of income. As an extension of this one might forecast 1966/67, 1967/68 enrollments, etc. and increment as before to obtain resultant incomes. This will be a subject for analysis in the forthcoming OIR-4C.

FIGURE 3

Basic Income Units of Ontario Universities as Computed by Formula
1963/64 - 1965/66



A bar chart comparison of formula-computed basic income units of Ontario universities is presented in Figure 3. This chart gives some indications of distribution trends, assuming of course, that the imputed income value is appropriate for all universities.

TABLE 2

PERCENTAGE DISTRIBUTION OF ALL ONTARIO BASIC INCOME UNITS BY INDIVIDUAL UNIVERSITY
1963/64 - 1965/66

	1963/64	1964/65	1965/66
Toronto	41.5	41.0	39.0
Western	11.8	10.0	11.1
Queens	10.1	10.0	10.3
McMaster	7.0	7.3	7.0
Waterloo	6.3	7.6	9.5
Carlton	4.6	4.9	4.9
Ottawa	9.4	8.8	7.7
Guelph	4.4	4.2	4.2
Windsor	3.5	3.6	3.5
York	1.0	1.2	1.3
Laurentian	0.6	0.8	1.1
Lakehead	0.2	0.4	0.6
Brock	0.0	0.2	0.4
Trent	0.0	0.1	0.3

Table 2 presents a percentage comparison of the distribution of income units to Ontario universities. It is evident that

University of Toronto is on a slight trend downward here especially in comparison to York, Brock and Trent which would probably be classed as emerging universities. With the exception of the latter and the smaller universities, the only university on a significant upward trend is Waterloo. This trend is borne out by Figure 3 also.

TABLE 3

BASIC INCOME UNITS PER STUDENT,
ONTARIO UNIVERSITIES, 1963/64-1965/66

	1963/64	1964/65	1965/66
Toronto	1.93	1.96	1.99
Western	1.64	1.57	1.65
Queens	1.75	1.80	1.80
McMaster	1.75	1.66	1.63
Waterloo	1.83	1.83	1.86
Carlton	1.46	1.49	1.51
Ottawa	2.03	1.99	1.98
Guelph	1.89	1.90	1.78
Windsor	1.47	1.54	1.47
York	1.27	1.16	1.44
Laurentian	1.04	1.05	1.06
Lakehead	1.00	1.13	1.11
Brock	0	1.00	1.05
Trent	0	1.00	1.05
Weighted Average	1.79	1.78	1.78

Table 3 presents an inter-university comparison of basic income units per student for the years under study. The method of presentation also provides for speculation about trends in this index. This is especially important because an upward trend for a university indicates that enrollment in the higher income producing categories is contributing a net favourable effect.

This might be illustrated better by selected data in Table 4 on two universities for the years 63/64 and 64/65.

TABLE 4

University	63/64			64/65			
	Income Units	Students	Ratio	Income Units	Students	Ratio	Net Change in Ratio
Queens	6455	3690	1.75	7234	4027	1.80	+0.05
Waterloo	4102	2242	1.83	5665	3104	1.83	-0-

In this example, through a slight net shift to higher income courses, Queens has been able to increase income per student while Waterloo, though increasing income substantially, has merely maintained a status quo.

It is significant that Waterloo does not indicate the pronounced upward trend here as in the previous analysis. While it is gaining rapidly in total income units the associated increase in students acts to maintain the index in a stable condition.

Additional Inferences

For the sake of brevity we have shown only a few examples of the types of analysis that may be performed. There is a wealth of information for analysis in the computer output reports. For example, if the objective were to maximize total income, each of the courses of study could be analyzed to determine where emphasis might be placed to maximize income. Illustrative of this is Table 5 which shows a comparison of enrollment and income units for courses 41 (All Ph.D.) and 1 (General Arts) in the accompanying report OIR-4B.

TABLE 5

Course	1963-64		1964-65		1965-66	
	Enrollment	Income Units	Enrollment	Income Units	Enrollment	Income Units
1	2423	2423	2672	2672	3006	3006
41	559	3354	746	4476	892	5352

The increase in enrollment and income units for course 1 averages close to 300 per year. For course 41 the increase in enrollment averages about 200 per year; but the increase in income units is close to 1000 a year!

On the surface the best strategy might appear to be "maximize income per student". To the extent that weights actually reflect true costs of processing students through courses of study this is sound. But, to use an industry analogy, we need to produce

at less cost than income in order to make a profit. The analogy holds here also. Income per student must exceed the marginal cost per student in order to realize a net favourable return. To put it more simply, using weights as income units, it would pay to promote the general arts course if the income to cost ratio were 1/.5 vis-a-vis the Ph.D. course which, for the sake of illustration, might show an income to cost ratio of 6/6.

From the point of view of economics, we need to know much more about the actual costs of processing students through courses of study before we can make really meaningful statements about what programs to emphasize. This information may be obtained only through application of a program budgeting and cost system. The Office of Institutional Research will present a brief, in the near future, on the feasibility of such a system and how it would be integrated with the Toronto Simulation Model (C.A.M.P.U.S.) now under development.

Future Prospects

OIR-4C, a follow-on study to be issued shortly will provide a similar kind of analysis on projected enrollment data using incremented values of basic income units. With this information one may speculate about what the effects would be over a range of income unit values. Pessimistic and optimistic limits may be set which can be used in evaluating future budget requests.

SOME ADDITIONAL QUESTIONS TO CONSIDER

1. What fraction of the (provincial) government grant in previous years should be deducted as additional aid to "emerging" universities?

2. What fraction of the University of Toronto basic income units must be subtracted because they "belong" to the federated colleges?

3. How are uncertainties in classifications of students at various universities (especially the University of Toronto) to be resolved?

4. How are various non-academic items in previous provincial grants to be removed? e.g., ROM, Royal Botanical Gardens, ONULP, Sinking fund payments, etc.

APPENDIX A

Table of Categories for Determining Basic Income Units

UNDERGRADUATE AND FIRST DEGREE

Code	Category 1	Weight 1
01	All General Arts	
02	All General Science	
03	All Pre-Medicine	
04	All Journalism	
05	All Secretarial Science	
06	All Social Work	
07	First-Year Honours Arts and Science	

Code	Category 2	Weight 1.5
08	Upper Years Honours Arts (including "make-up" year)	
09	All Commerce	
10	All Physical Education	
11	All Law	
12	All Library Science	
13	All Fine and Applied Arts	
14	All Physical and Occupational Therapy	

Code	Category 3	Weight 2
15	Upper Years Honours Science (including "make-up" year)	
16	All Nursing	
17	All Engineering	
18	All Food and Household Sciences	
19	All Pharmacy	
20	All Architecture	
21	All Forestry	
22	All Agriculture	
23	All Hygiene and Public Health	
24	All Music	

Code	Category 4	Weight 3
25	All Medicine	
26	All Dentistry	
27	All Veterinary Medicine	

GRADUATE

Code	Category 5	Weight 2
	Masters' Level (and First-Year Ph.D. direct from Baccalaureate)	
28	Commerce and Business Administration	
29	Social Work	

Code	Category 6	Weight 3
	Masters' Level (and First-Year Ph.D. direct from Baccalaureate)	
30	Humanities	
31	Social Sciences	
32	Mathematics	
33	Law	
34	M.Phil.	
35	Other Graduates	

Code	Category 7	Weight 4
	Masters' Level (and First-Year Ph.D. direct from Baccalaureate)	
36	Psychology	
37	Geography	
38	Engineering	
39	Science	
40	Medicine	

Code	Category 8	Weight 6
41	All Ph.D. (except First-Year Ph.D. direct from Baccalaureate)	

Code	Category 9	Weight 1
42	Dissertation or thesis only	

APPENDIX B

SOURCES OF DATA

Data for the study were collected from several sources. Mr. Ivor S. Joshua, Financial Representative of the Department of University Affairs, very kindly furnished us with student fee income for all universities for the years under study. Mrs. F. A. Ireland, Research Assistant to the President, and Mr. George Court, Director of Finance, both of the University of Toronto, provided provincial and federal grant information respectively.